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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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09/492,780 01/28/00 MATSUO

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EXAMINER

MM91/1019

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RAD.S

ART UNIT

PAPER NUMBER

2814

DATE MAILED:

10/19/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.

09/492,780

Applicant(s)

MATSUO ET AL.

Examiner

Steven H. Rao

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 02 July 2001.
- 2a) ☐ This action is **FINAL**.
- 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☐ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) 1-11, 19 and 20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☐ Claim(s) 12-18 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Election/Restrictions

Applicant's election without traverse of July 02, 2001 in Paper No. 5 is acknowledged.

Claims 1-11, 19 and 20 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a non elected group, there being no allowable generic or linking claim.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 16 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 16 recites, "The semiconductor device according to claim 12 , wherein said metal-containing insulating film further comprises a covering insulating region covering at least one surface of a main insulating region consisting of said first insulating regions and said second insulating region and formed of an amorphous insulating material equal to that constituting said second insulating region."

It is not understood what applicants' mean by "said metal-containing insulating film further comprises a covering insulating region covering at least one surface of a main insulating region consisting of said first insulating regions".

It is not understood what applicants' mean by, "formed of an amorphous insulating material equal to that constituting said second insulating region."

Appropriate correction is required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 12-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over anticipated by Hu (U.S. Patent no. 5,962,904, herein after Hu) and Wittmer article (Applicnats' Ids , Wittmer, M. et al," oxidation Kinetics of TiN thin films", J. App. Phys. Vol. 52, pp. 6659-6664, herein after Wittmer).

With respect to claim 12, Hu describes a semiconductor device including : a semiconductor substrate (Hu fig.4 # 12), a metal-containing insulating film formed directly or indirectly on the semiconductor substrate having a plurality of first insulating regions formed grains containing a metal oxide (Hu fig. 4 # 14).

Hu does not specifically describe its insulating films as being formed of metal oxide.

However Wittmer describes the well known in the art insulating films of metal oxides like TiO₂ that are semi insulating and with high resistivities.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use the material specified by Wittmer namely TiO_2 as the insulative layer instead of the well known SiO_2 to achieve layers with high resistivities in small devices (Wittmer abstract).

A second insulating region formed of an amorphous insulating material in a region expect the first insulating regions(Hu fig.4 # 18, col. 5 line 55) and an electrode formed on the metal –containing insulating film. (Hu fig. 3, col. 5 lines 14-16).

With respect to claim 13, Hu and Wittmer describes a semiconductor device including : wherein the first insulating region contains a crystalline metal oxide (Wittmer page 6660 right hand column line 19) and the second insulating region having silicon,oxygen and metal (Wittmer page 6660 right hand column line 25).

With respect to claim 14, Hu and Wittmer describes a semiconductor device including :

Wherein the metals of the first and second region differ from one another (Hu col. 4 lines 5-11).

With respect to claim 15, Hu and Wittmer describes a semiconductor device including : first insulating region is crystalline and second insulating region is amorphous (Hu layer 14 is crystalline and 18 is amorphous).

With respect to claim 16, to the extent understood ,Hu and Wittmer describes a semiconductor device including : said metal-containing insulating film further comprises a covering insulating region covering at least one surface of a main insulating region consisting of said first insulating regions and said second insulating region and formed

of an amorphous insulating material equal to that constituting said second insulating region (Hu figs. 1 to 4).

Claims 17-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hu (U.S. Patent no. 5,962,904, herein after Hu) and Wittmer article (Applicnats' lds , Wittmer, M. et al," oxidation Kinetics of TiN thin films", J. App. Phys. Vol. 52, pp. 6659-6664, herein after Wittmer) as applied to claims 12-16 above, and further in view of Nakajima et al. (U.S. Patent No. 5,907,188, herein after Nakajima).

With respect to claim 17, Hu and Wittmer describes a semiconductor device including : the first metal oxide, second metal oxide and the gate electrode

Hu and Wittmer do not specifically describe the decrease of the Gibbs free energy at the time when a metal constituting the gate electrode forms an oxide layer is larger than that at the time when a metal constituting the first metal oxide film forms an oxide , and the decrease of the Gibbs free energy at the time when a metal constituting the second metal oxide film forms an oxide is larger than or equal to that at the time when metal constituting the gate electrode forms an oxide.

However Nakajima in col. 11 lines 14-24 describes the decrease of the Gibbs free energy at the time when a metal constituting the gate electrode forms an oxide layer is larger than that at the time when a metal constituting the first metal oxide film forms an oxide , and the decrease of the Gibbs free energy at the time when a metal constituting the second metal oxide film forms an oxide is larger than or equal to that at the time when metal constituting the gate electrode forms an oxide to obtain a device that has excellent electrical characteristics and highly reliable can be obtained.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to include the specific Gibbs free energy parameters in Hu's and Wittmer's device to obtain a device that has excellent electrical characteristics and highly reliable can be obtained.

With respect to claim 18, Hu, Wittmer and Nakajima describe a semiconductor device including : wherein the second metal oxide film is selected from the group consisting of Titanium, Zirconium, Hafnium, Tantalum and Niobium oxide and the gate electrode from the nitrides of the afore mentioned metals. (See Hu 4 lines 5-10).

Any inquiry concerning this communication should be directed to Steven H. Rao at telephone number 703-306-5945.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 703- 306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703- 308-0956.

SC
18/17/01

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